

SAP Worksheet #15a—Reference Limits and Evaluation Soil Gamma Spectroscopy

Matrix: Soil

Analytical Group: Radiological (gamma spectroscopy) – USEPA Method 901.1

Analyte	CAS	Project Remediation Goal ^a (pCi/g)	Project Remediation Goal Reference	Project QL Goal ^b (pCi/g)	Laboratory-Specific Limits ^{c,d,e,f,g}
					MDC (pCi/g)
¹³⁷ Cs	10045-97-3	0.113	ROD	0.05	0.05
²²⁶ Ra ^h	13982-63-3	1.0	ROD	0.1	0.1
Bismuth-214 (²¹⁴ Bi)	14913-49-6	none	--	0.1	0.1
Lead-214 (²¹⁴ Pb)	15067-28-4	none	--	0.1	0.1
Potassium-40 (⁴⁰ K)	13966-00-2	none	--	0.5	0.5
Actinium-228 (²²⁸ Ac)	14331-83-0	none	--	0.3	0.3
Bismuth-212 (²¹² Bi)	14913-49-6	none	--	1.0	1.0
²¹² Pb	15092-94-1	none	--	0.1	0.1
Americium-241 (²⁴¹ Am)	14596-10-2	none	--	0.3	0.3
Protactinium-234 (²³⁴ Pa)	15100-28-4	none	--	0.75	0.75
²³² Th	7440-29-1	none	--	0.3	0.3
Thallium-208 (²⁰⁸ Tl)	14913-50-9	none	--	0.1	0.1

Notes:

- ^a The project RGs are based on those provided in the Parcel G ROD, (Navy, 2009). The RGs will be applied as concentrations above background.
- ^b Project Quantitation Limit (QL) goals for individual samples are equal to the MDC and will be a maximum of 90 percent of the RG.
- ^c Results for non-aqueous samples are reported on a dry-weight basis.
- ^d The MDC is an estimate of the smallest true activity (or activity concentration) of an analyte in a sample that results in a 95 percent probability of detection, given a detection criterion that includes a 5 percent probability of false detection in an analyte-free sample. MDCs may vary from sample to sample depending on the composition of the sample matrix. Any changes to these limits that affect the project SAP objectives must be approved by the Navy RPM and QAO in writing in advance of sample testing.
- ^e Gamma spectroscopy analyses will be based on meeting the MDCs for ¹³⁷Cs and ²²⁶Ra. MDCs for other radionuclides analyzed by gamma spectroscopy are not required to be achieved unless specifically requested on the applicable contaminant of concern. All detected radionuclides will be reported by the laboratory.
- ^f Daughter products and naturally occurring isotopes will be reported in the gamma spectroscopy results, which may include, ⁴⁰K, ²⁰⁸Tl, ²¹²Bi, ²¹²Pb, ²¹⁴Bi, ²¹⁴Pb, radium-223, radium-224, thorium-227, ²²⁸Ac, Thorium-228 (²²⁸Th), Protactinium-231, ²³⁴Pa, Protactinium-234m.
- ^g The SOPs reflect standard method MDCs that are the default values if a project does not specify a site-specific detection limit. The MDCs listed in this worksheet can be achieved with larger aliquots or longer count times within the constraints of the method in order to achieve project objectives. MDC is the minimum detectable concentration, which is an equivalent calculation to the minimum detectable activity (MDA).
- ^h ²²⁶Ra background will be established as described in this SAP and the Parcel G Work Plan. The ²¹⁴Bi 609 kiloelectron volt (keV) energy peak will be used to quantify ²²⁶Ra following a 21-day in-growth period.

CAS = Chemical Abstracts Service

SAP Worksheet #15b—Reference Limits and Evaluation Soil Alpha Spectroscopy

Matrix: Soil

Analytical Group: Radiological (alpha spectroscopy) – United States Department of Energy (USDOE) Method HASL-300 A-01-R

Analyte	CAS	Project Remediation Goal ^a (pCi/g)	Project Remediation Goal Reference	Project QL Goal ^b (pCi/g)	Laboratory-Specific Limits ^{c, d, e}
					MDC (pCi/g)
²²⁶ Ra ^f	13982-63-3	1.0	ROD	0.1	0.1
²⁴¹ Am	14596-10-2	none	--	0.5	0.5
Plutonium-238 (²³⁸ Pu)	13981-16-3	none	--	0.5	0.5
^{239/240} Pu ^g	15117-48-3	2.59	ROD	0.5	0.5
²³⁴ U	13966-29-5	none	--	0.5	0.5
^{235/236} U ^h	15117-96-1	none	--	0.175	0.175
²³⁸ U	7440-61-1	none	--	0.5	0.5
²²⁸ Th	14274-82-9	none	--	1.0	1.0
²³⁰ Th	14269-63-7	none	--	0.5	0.5
²³² Th ⁱ	7440-29-1	none	--	1.0	1.0

Notes:

- ^a The RGs are based on those provided in the Parcel G ROD (Navy, 2009). The RGs will be applied as concentrations above background.
- ^b Project QL goals for individual samples are equal to the MDC and will be a maximum of 90 percent of the RG.
- ^c Results for non-aqueous samples are reported on a dry-weight basis.
- ^d The MDC is an estimate of the smallest true activity (or activity concentration) of an analyte in a sample that results in a 95 percent probability of detection, given a detection criterion that includes a 5 percent probability of false-detection in an analyte-free sample. MDCs may vary from sample to sample depending on the composition of the sample matrix. Any changes to these limits that affect the project SAP objectives, must be approved by the Navy RPM and QAO in writing in advance of sample testing.
- ^e The SOPs reflect standard method MDCs that are the default values if a project does not specify a site-specific detection limit. The MDC listed in this worksheet can be achieved with larger aliquots or longer count times within the constraints of the method in order to achieve project objectives. MDC is the minimum detectable concentration, which is an equivalent calculation to the MDA.
- ^f Where possible, isotopic analysis for ²²⁶Ra will be performed using the same dissolution/digestion as ²³⁸U to ensure comparability of results. If analysis of ²²⁶Ra is not possible due to interferences, radon emanation (**Worksheet #15d**) will be performed. All detected radium isotopes will be reported.
- ^g ²³⁹Pu is listed in the above table as ^{239/240}Pu because the alpha energy peaks for the isotope of plutonium cannot be separated in alpha spectroscopy. Therefore, the laboratory will report as listed above in the table. All detected plutonium isotopes will be reported.
- ^h ²³⁵U is listed in the above table as ^{235/236}U because the alpha energy peaks for the isotope of uranium cannot be separated in alpha spectroscopy. Therefore, the laboratory will report as listed above in the table. All detected uranium isotopes will be reported.
- ⁱ All detected thorium isotopes will be reported.

SAP Worksheet #15c—Reference Limits and Evaluation Soil Gas Flow Proportional Counting

Matrix: Soil

Analytical Group: Radiological (GFPC) – USEPA Method 905.0 mod

Analyte	CAS	Project Remediation Goal ^a (pCi/g)	Project Remediation Goal Reference	Project QL Goal ^b (pCi/g)	Laboratory-Specific Limits ^{c,d,e}
					MDC (pCi/g)
⁹⁰ Sr	10098-97-2	0.331	ROD	0.15	0.15

Notes:

- ^a The RGs are based on those provided in the Parcel G ROD, (Navy, 2009). The RGs will be applied as concentrations above background.
- ^b Project QL goals for individual samples are equal to the MDC and will be a maximum of 90 percent of the RG.
- ^c Results for non-aqueous samples are reported on a dry-weight basis.
- ^d The MDC is an estimate of the smallest true activity (or activity concentration) of an analyte in a sample that ensures a 95 percent probability of detection, give a detection criterion that includes a 5 percent probability of detection in an analyte-free sample. MDCs may vary from sample to sample depending on the composition of the sample matrix. Any changes to these limits that affect the project SAP objectives must be approved by the Navy RPM and QAO in writing in advance of sample testing.
- ^e The SOPs reflect standard method MDCs that are the default values if a project does not specify a site-specific detection limit. The MDC listed in this worksheet can be achieved with larger aliquots or longer count times within the constraints of the method in order to achieve project objectives. MDC is the minimum detectable concentration, which is an equivalent calculation to the MDA.

SAP Worksheet #15d—Reference Limits and Evaluation Soil Radon Emanation

Matrix: Soil

Analytical Group: Radiological (Radon Emanation) – USEPA Method 903.1 mod

Analyte	CAS	Project Remediation Goal ^a (pCi/g)	Project Remediation Goal Reference ^a	Project QL Goal ^b (pCi/g)	Laboratory-Specific Limits ^{c,d,e}
					MDC (pCi/g)
²²⁶ Ra ^e	13982-63-3	1.0	ROD	0.1	0.1

Notes:

- ^a The RGs are based on those provided in the Parcel G ROD, (Navy, 2009). The RGs will be applied as concentrations above background.
- ^b The Project QL goals for individual samples are equal to the MDC and will be a maximum of 90 percent of the RG.
- ^c Results for non-aqueous samples are reported on a dry-weight basis.
- ^d The MDC is an estimate of the smallest true activity (or activity concentration) of an analyte in a sample that results in a 95 percent probability of detection, given a detection criterion that includes a 5 percent probability of false detection in an analyte-free sample. MDCs may vary from sample to sample depending on the composition of the sample matrix. Any changes to these limits that affect the project SAP objectives must be approved by the Navy RPM and QAO in writing in advance of sample testing.
- ^e The SOPs reflect standard method MDCs that are the default values if a project does not specify a site-specific detection limit. The MDC listed above can be achieved with larger aliquots or longer count times within the constraints of the method in order to achieve project objectives. MDC is the minimum detectable concentration, which is an equivalent calculation to the MDA.
- ^f ²²⁶Ra background will be established as described in the Parcel G Work Plan.